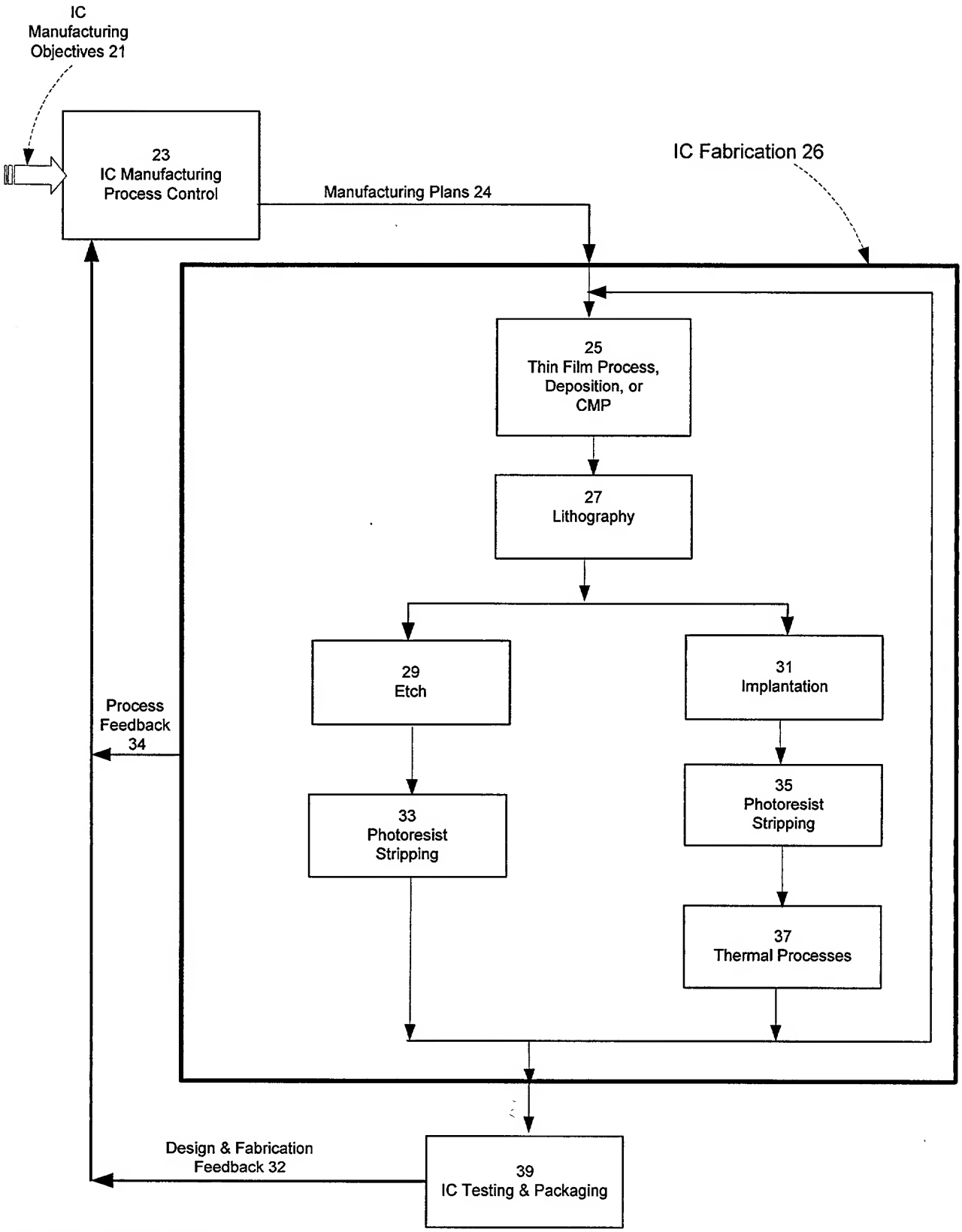

FIGURE 1 PRIOR ART

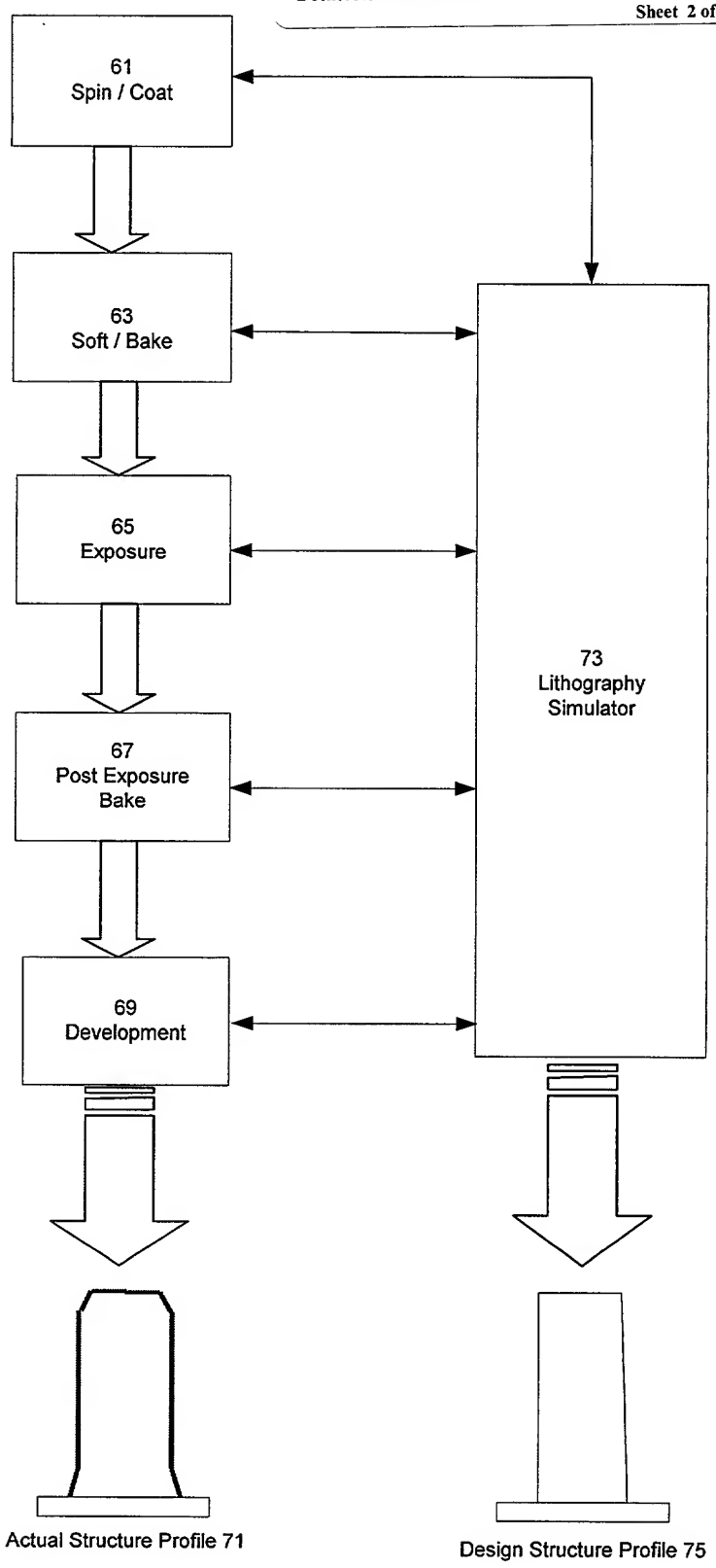

FIGURE 2 PRIOR ART

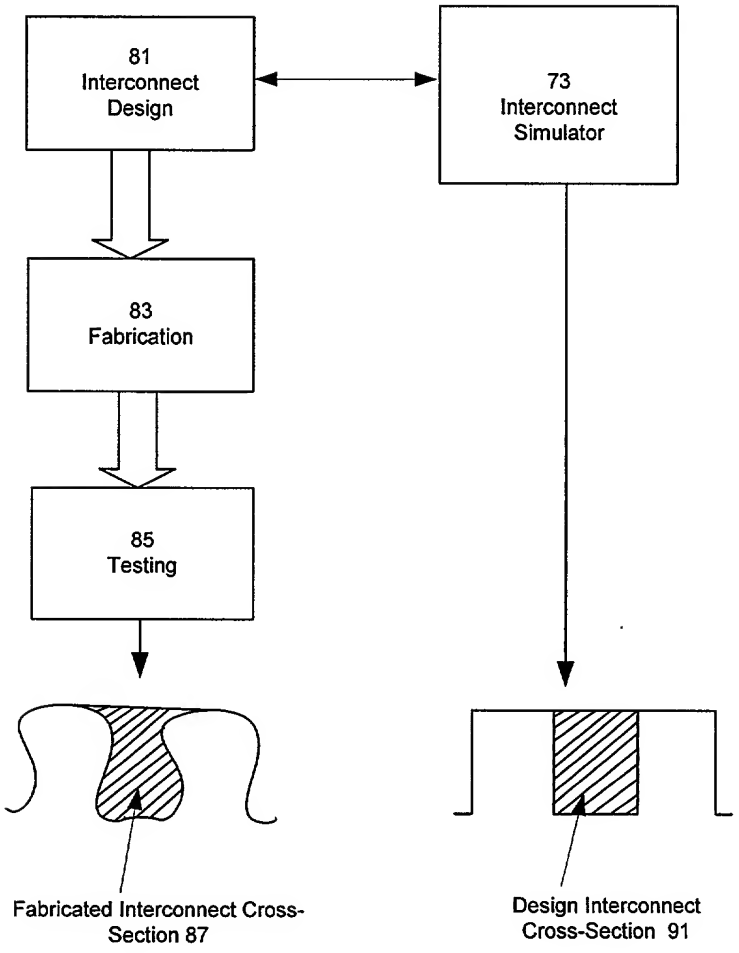

FIGURE 3 PRIOR ART

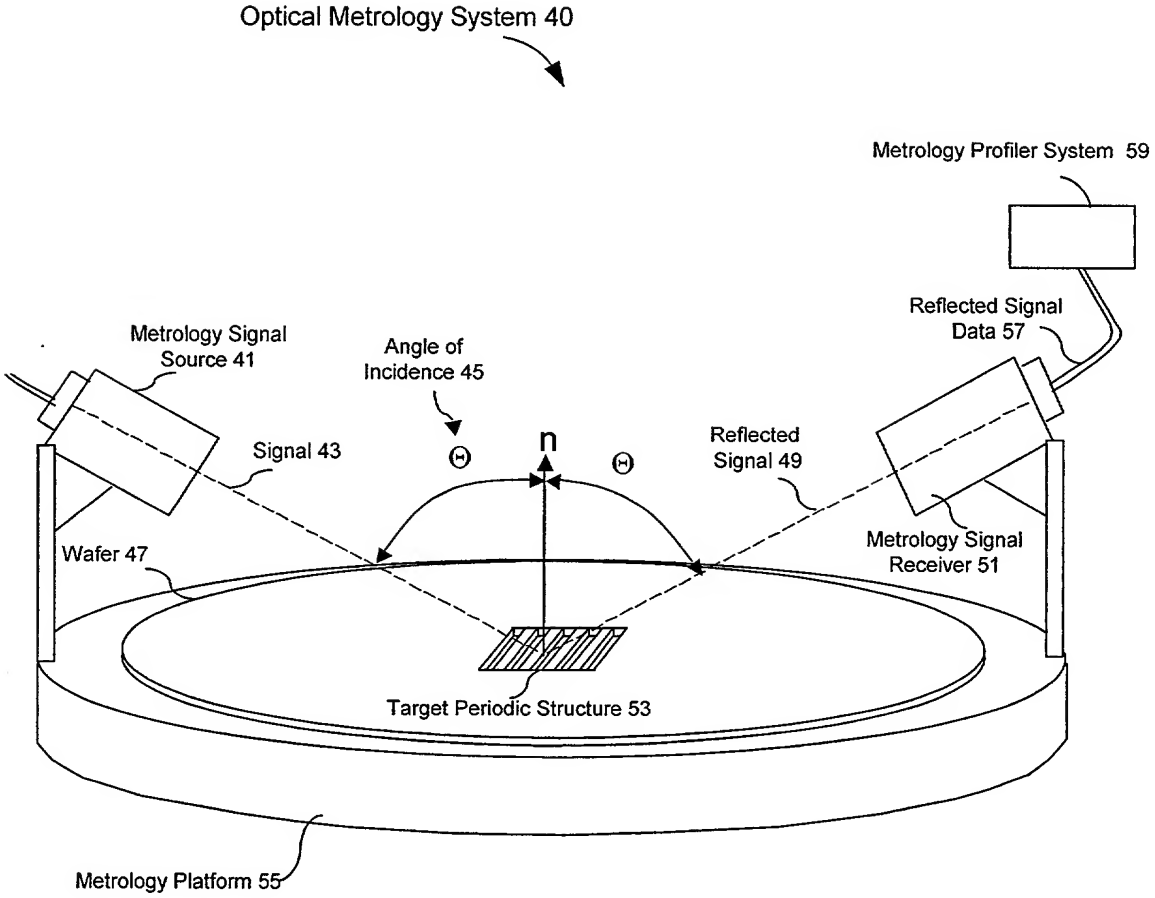
Optical Metrology System 40
Metrology Profiler System 59
Reflected Signal Data 57
Metrology Signal Source 41
Angle of Incidence 45
Signal 43
Θ
n
Θ
Reflected Signal 49
Metrology Signal Receiver 51
Wafer 47
Target Periodic Structure 53
Metrology Platform 55

FIGURE 4

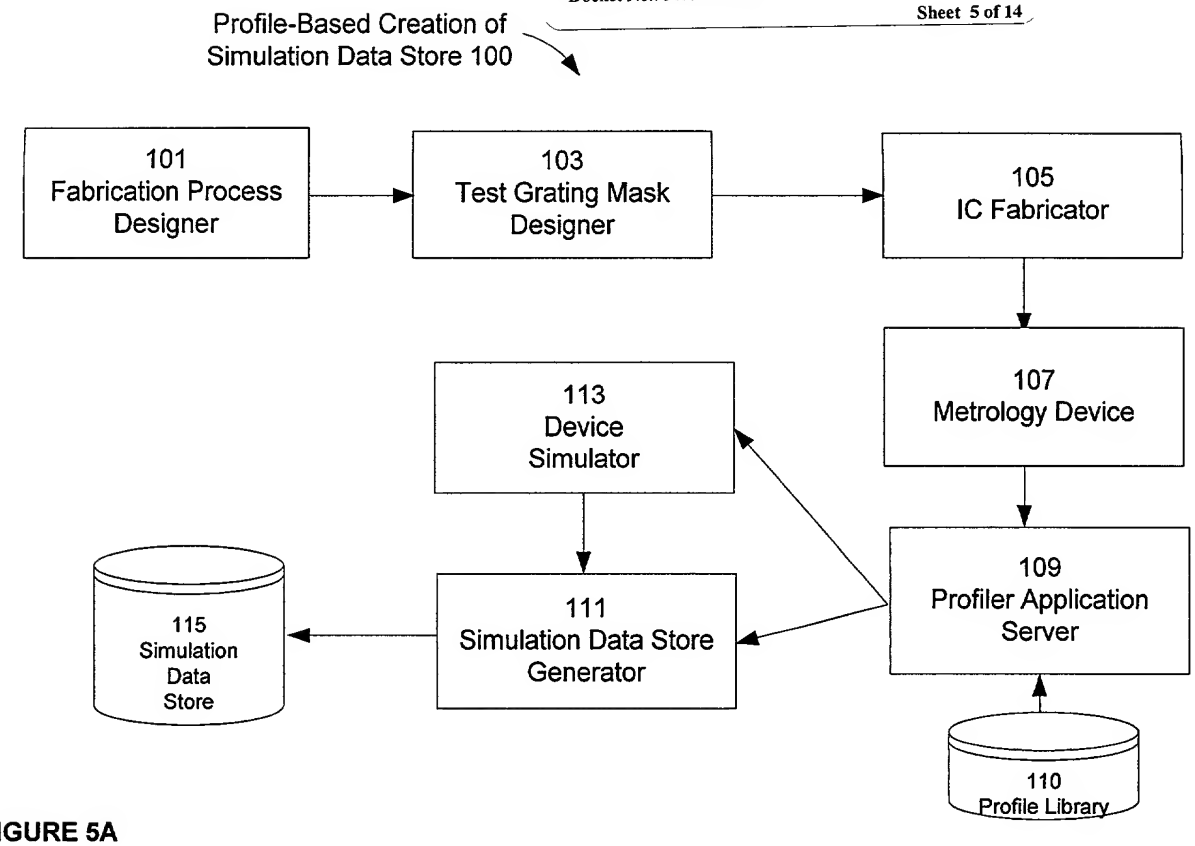

FIGURE 5A

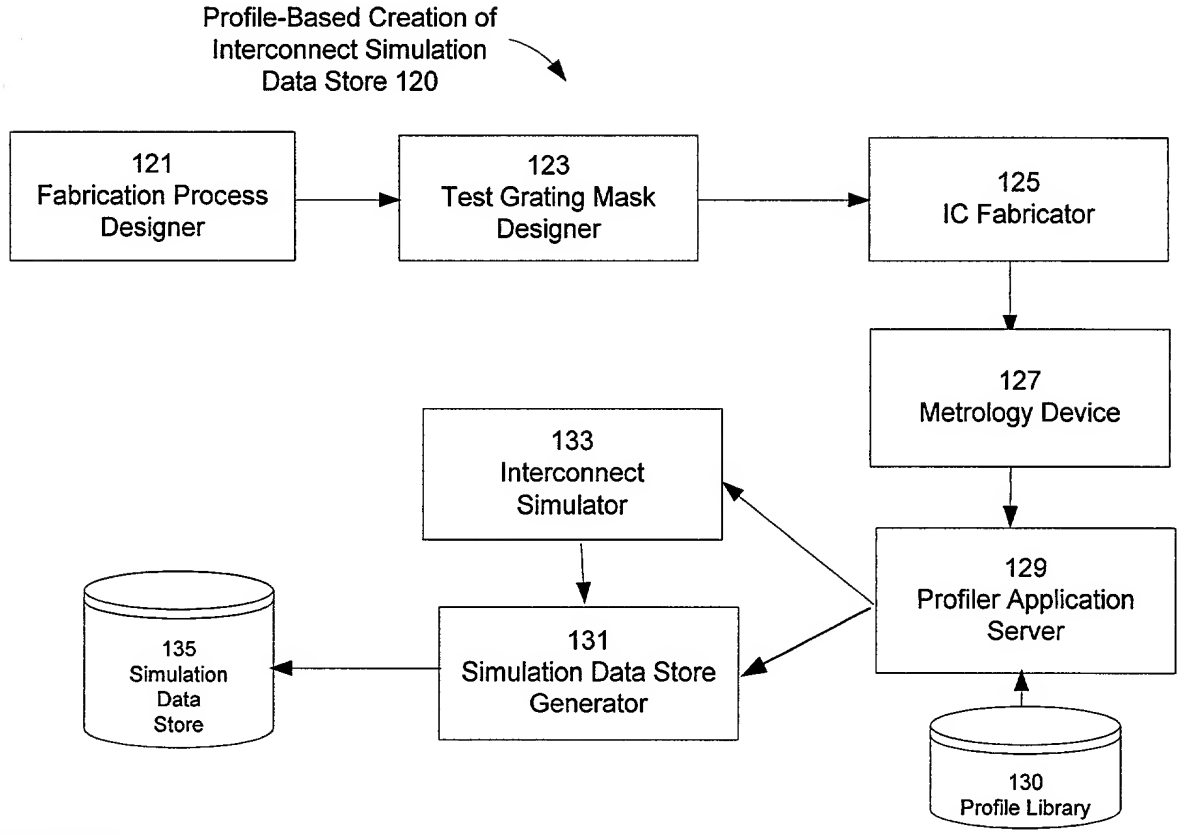

FIGURE 5B

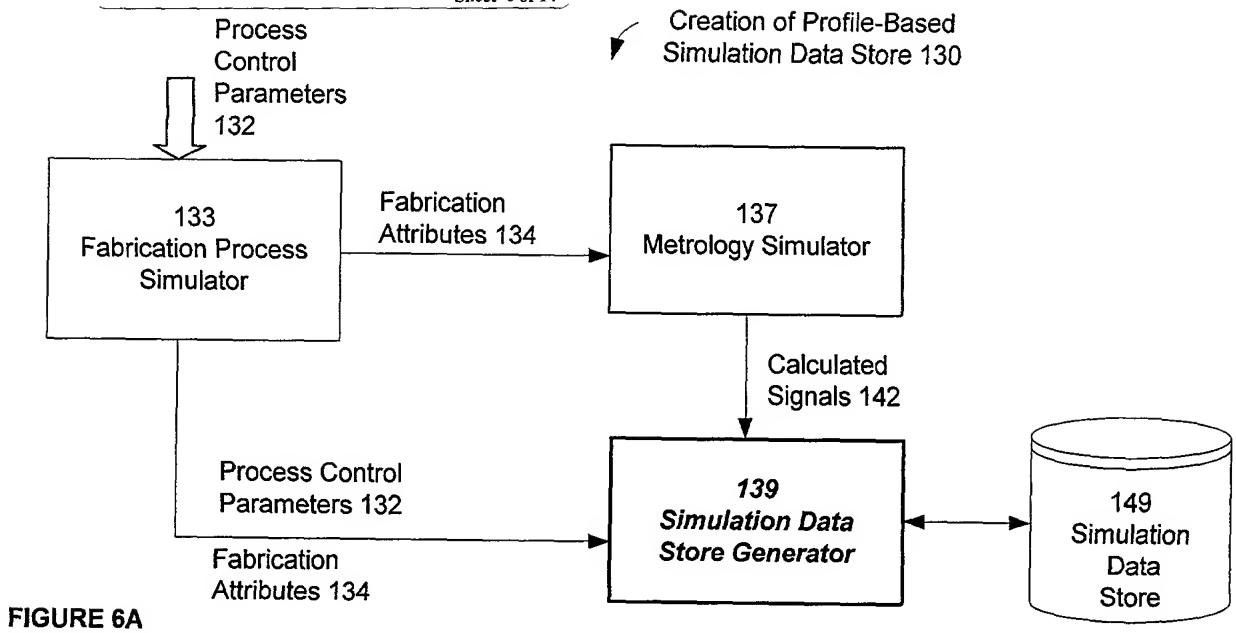

FIGURE 6A

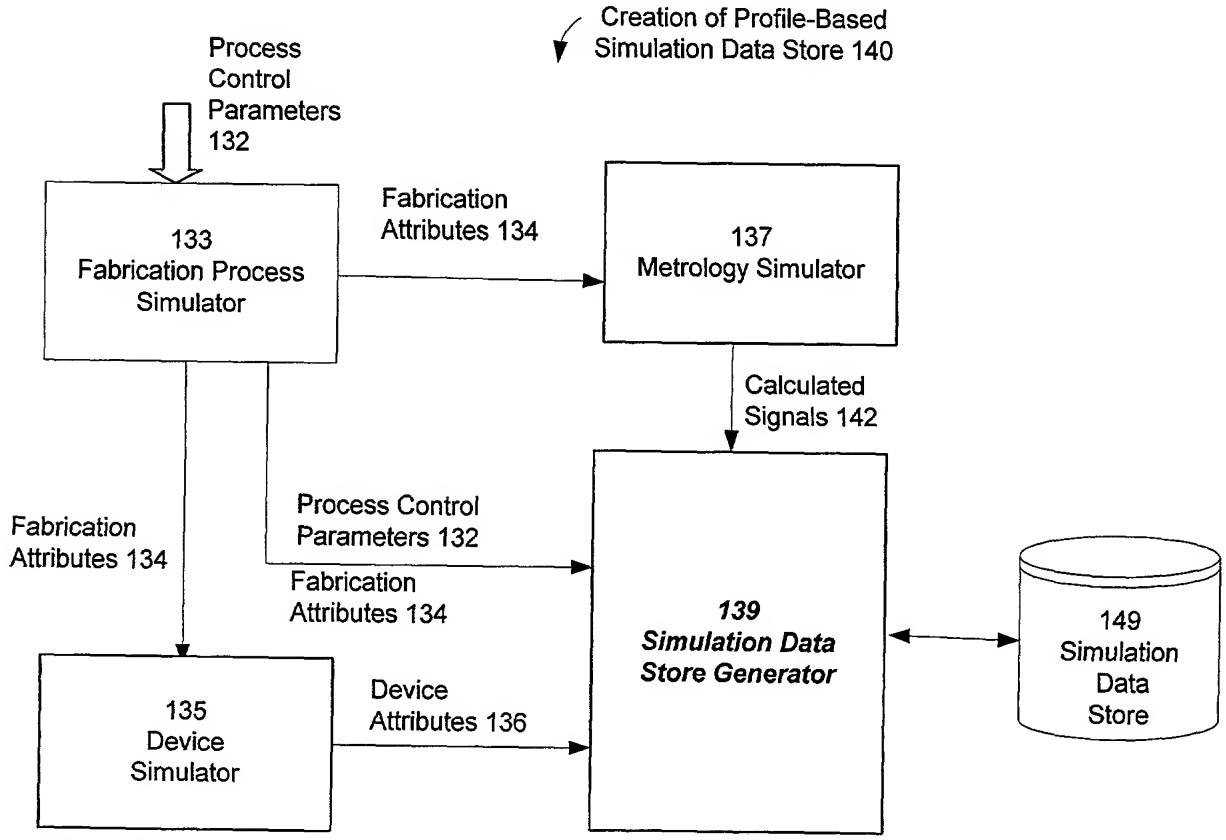

FIGURE 6B

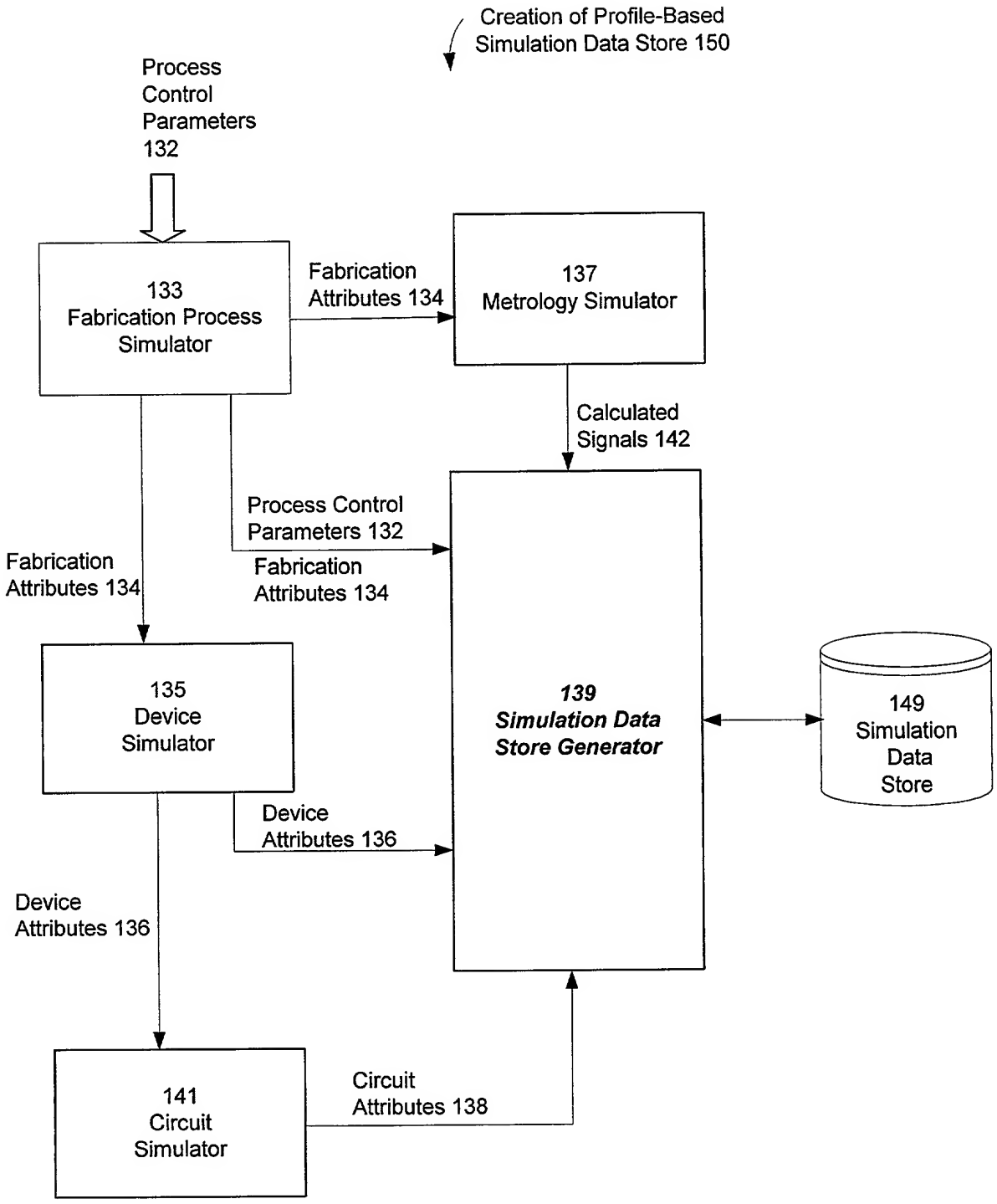
Creation of Profile-Based Simulation Data Store 150
Process Control Parameters 132
133 Fabrication Process Simulator
Fabrication Attributes 134
137 Metrology Simulator
Calculated Signals 142
Process Control Parameters 132
Fabrication Attributes 134
Fabrication Attributes 134
135 Device Simulator
139 Simulation Data Store Generator
149 Simulation Data Store
Device Attributes 136
Device Attributes 136
141 Circuit Simulator
Circuit Attributes 138

FIGURE 6C

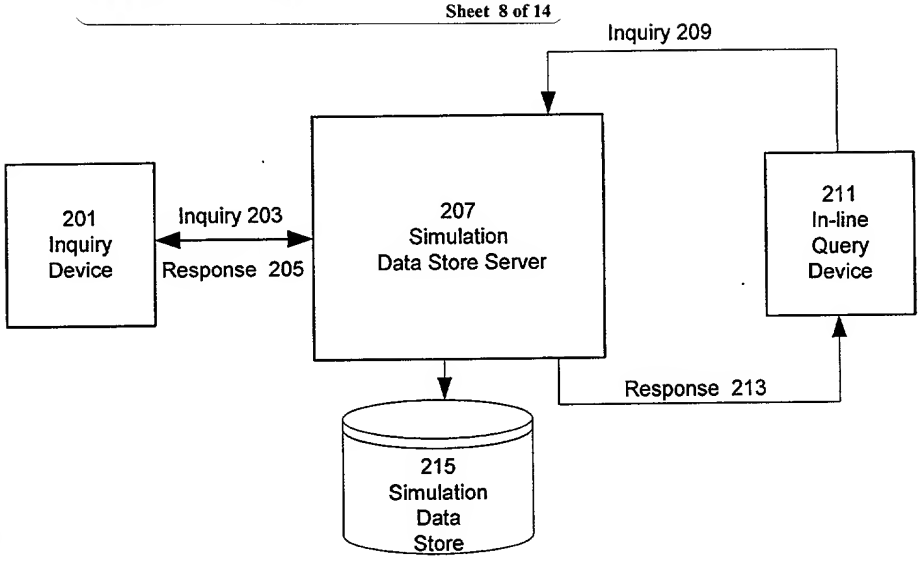

FIGURE 7A

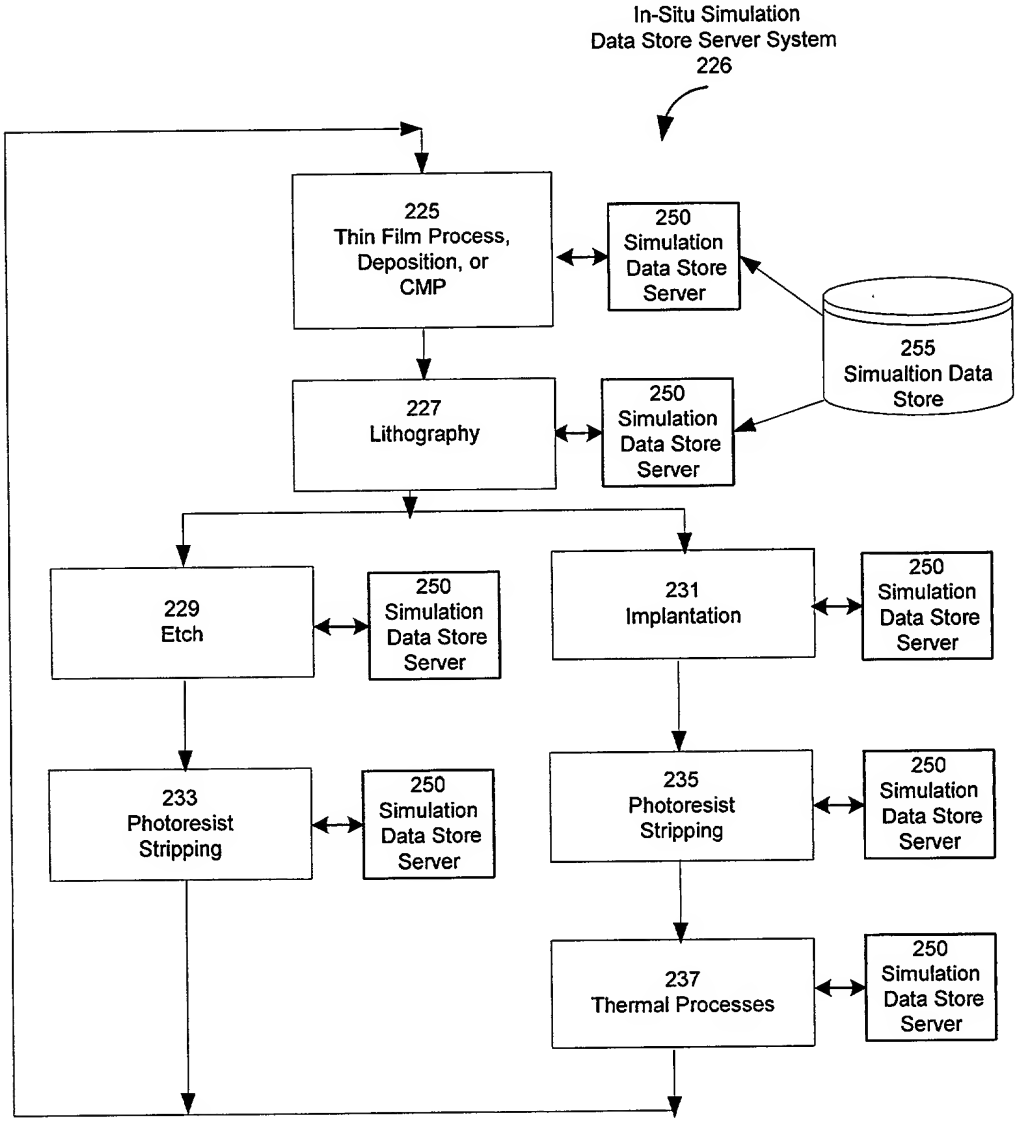

FIGURE 7B

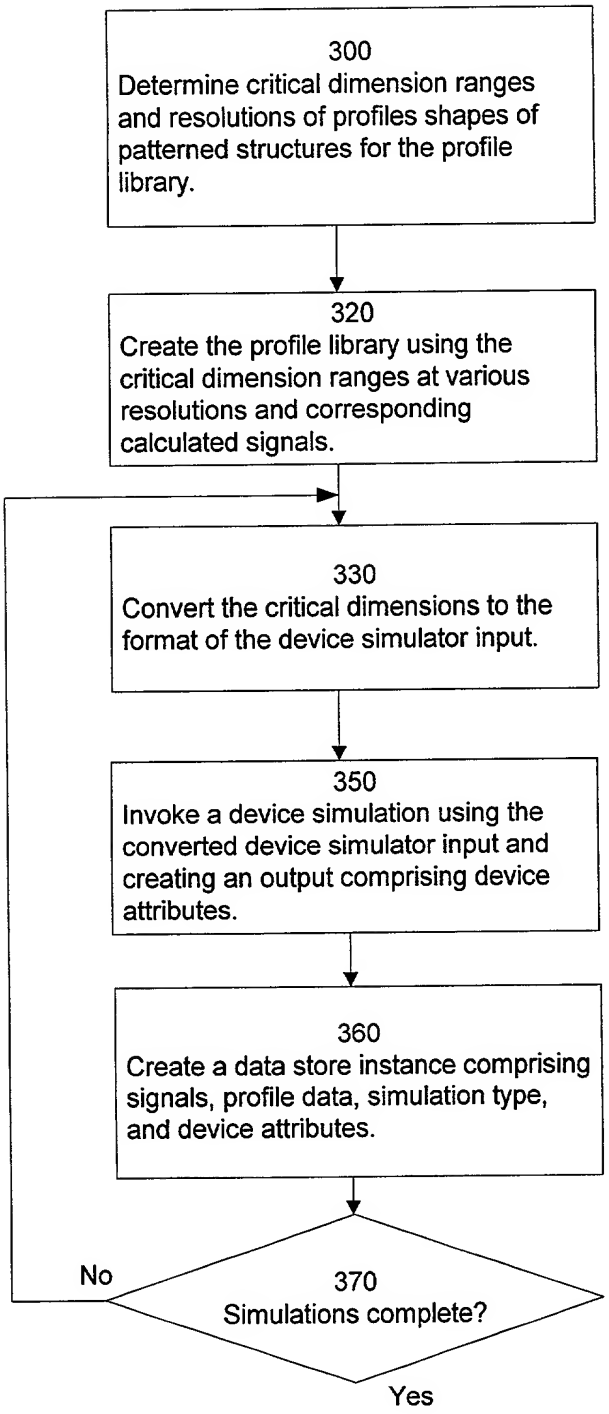
300
Determine critical dimension ranges and resolutions of profiles shapes of patterned structures for the profile library.
320
Create the profile library using the critical dimension ranges at various resolutions and corresponding calculated signals.
330
Convert the critical dimensions to the format of the device simulator input.
350
Invoke a device simulation using the converted device simulator input and creating an output comprising device attributes.
360
Create a data store instance comprising signals, profile data, simulation type, and device attributes.
370
Simulations complete?
No
Yes

FIGURE 8A

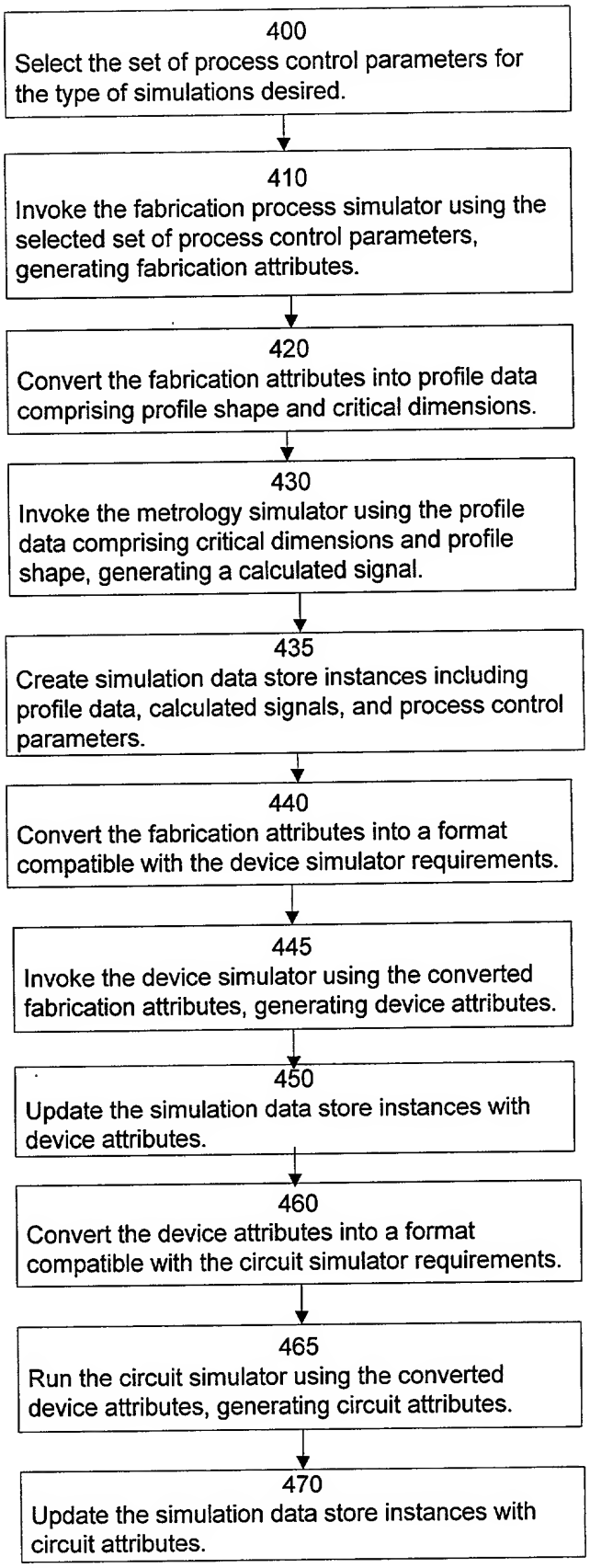
400
Select the set of process control parameters for the type of simulations desired.
410
Invoke the fabrication process simulator using the selected set of process control parameters, generating fabrication attributes.
420
Convert the fabrication attributes into profile data comprising profile shape and critical dimensions.
430
Invoke the metrology simulator using the profile data comprising critical dimensions and profile shape, generating a calculated signal.
435
Create simulation data store instances including profile data, calculated signals, and process control parameters.
440
Convert the fabrication attributes into a format compatible with the device simulator requirements.
445
Invoke the device simulator using the converted fabrication attributes, generating device attributes.
450
Update the simulation data store instances with device attributes.
460
Convert the device attributes into a format compatible with the circuit simulator requirements.
465
Run the circuit simulator using the converted device attributes, generating circuit attributes.
470
Update the simulation data store instances with circuit attributes.

FIGURE 8B

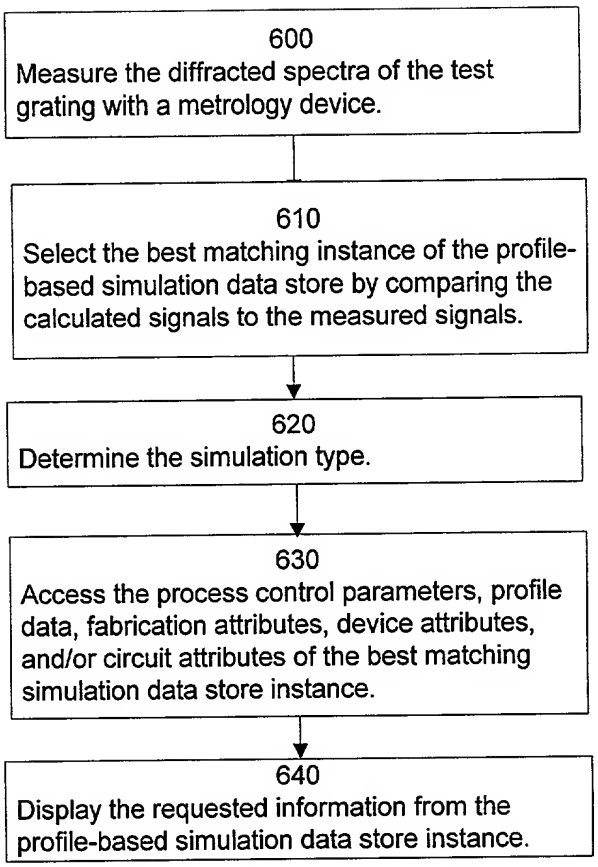

FIGURE 9A

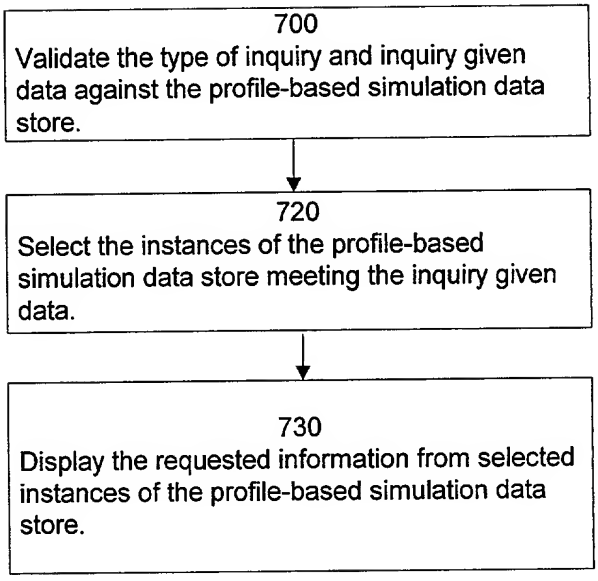

FIGURE 9B

Simulation Data Store Format 800

801 Signal	803 Profile Data	804 Simulation Data Segment		
		805 Simulation Type	807 Process Control Parameters or Input Parameters	809 Fabrication, Device and/or Circuit Attributes

where the Simulation Data Segment comprising Simulation Type, and Process Control Parameters or Input Parameters, and Fabrication, Device, and/or Circuit Attributes occurs n number of times and where Simulation Type may be:

Fabrication Process Simulation:
- Lithography Simulation
- Implantation Simulation
- Oxidation Simulation
- CMP Simulation
- 2- Dimensional Process Simulation
- Other Fabrication Process Simulation.
- Diffusion Simulation
- Deposition and Etching Simulation
- Deposition and Reflow Simulation
- 3- Dimensional Fabrication Simulation.

Device Simulation
- Interconnect Simulation
- Electrostatic Discharge Simulation
- Optical Device Simulation
- Power Device Simulation
- Compound Device Simulation
- Other Device Simulation

Circuit Simulation
- Transient Simulation
- Signal Integrity Simulation
- Noise Simulation
- Other Circuit Simulation

Combined Fabrication Process & Device Simulation
Combined Device & Circuit Simulation
Combined Fabrication Process, Device & Circuit Simulation

FIGURE 10

Example 1: Interconnect Device Simulation

801 -Signal: Values representing Tan (Ψ) and Cos (Δ) for a periodic structure diffracted spectra
803 - Profile Data:
Top Critical Dimension (CD), nanometers (nm)
Bottom CD, nm
Height, nm
Trapezoidal Profile with Footing
804 - Simulation Data Segment
805 - Simulation Type: Interconnect Device Simulation
807 - Input Parameters:
Profile Data
Other Device Simulation Input Parameters
809 - Device Attributes
Capacitance, farads
Inductance, henrys
Resistance, ohms
Other Electrical & Thermal Device Attributes

Example 2: Fabrication Process & Device Simulation

801 -Signal: Values representing Tan (Ψ) and Cos (Δ) for a periodic structure diffracted spectra
803 - Profile Data:
Top critical dimension (CD), nanometers (nm)
Bottom CD, nm
Height, nm
Trapezoidal profile with footing
804 - Simulation Data Segment 1
805 - Simulation Type: Lithography & Etch Simulation
807 - Input Parameters:
Numerical aperture
Post Exposure Bake Temperature
Anti-Reflective Coating Thickness
Exposure Time
Focus
Exposure
Resist Thickness
Other Fabrication Process Control Parameters
809 - Fabrication Process Attributes
Profile Data
Other Fabrication Process Attributes
804 - Simulation Data Segment 2
805 - Simulation Type: Interconnect Device Simulation
807 - Input Parameters:
Profile Data
Other Device Simulation Input Parameters
809 - Device Attributes
Capacitance, farads
Inductance, henrys
Resistance, ohms
Other Electrical & Thermal Device Attributes

FIGURE 10 Continued

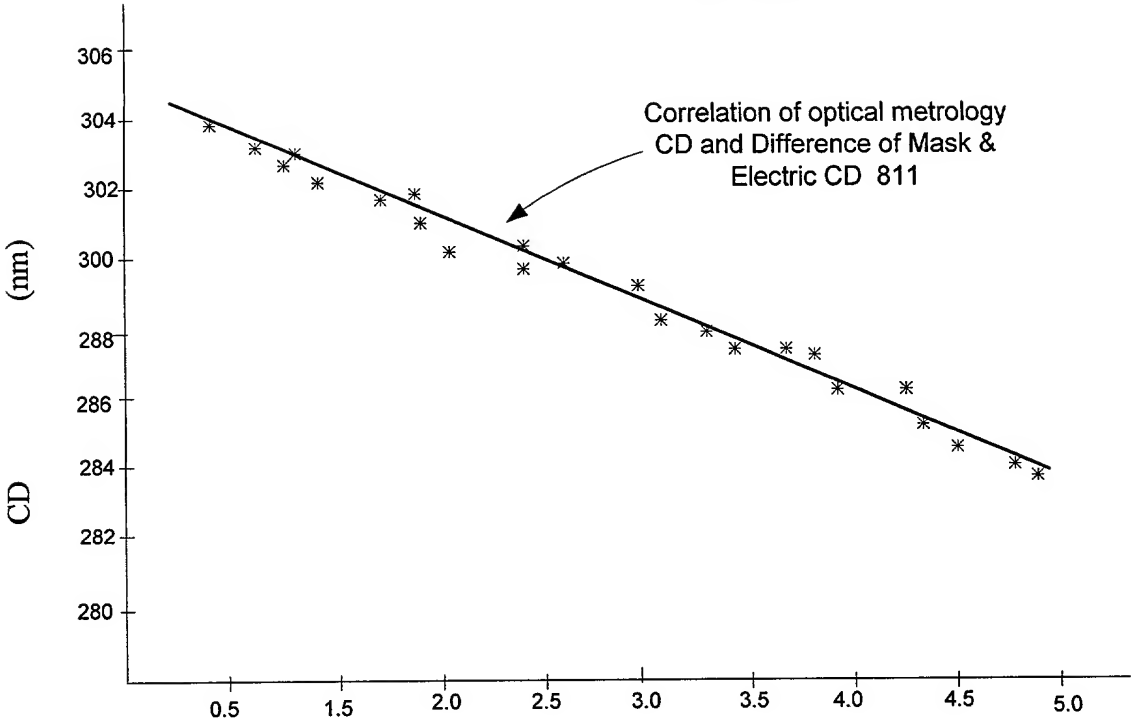

FIGURE 11A

$$\Delta W = CD_{MASK} - CD_{ELECTRIC} \text{ (nm)}$$

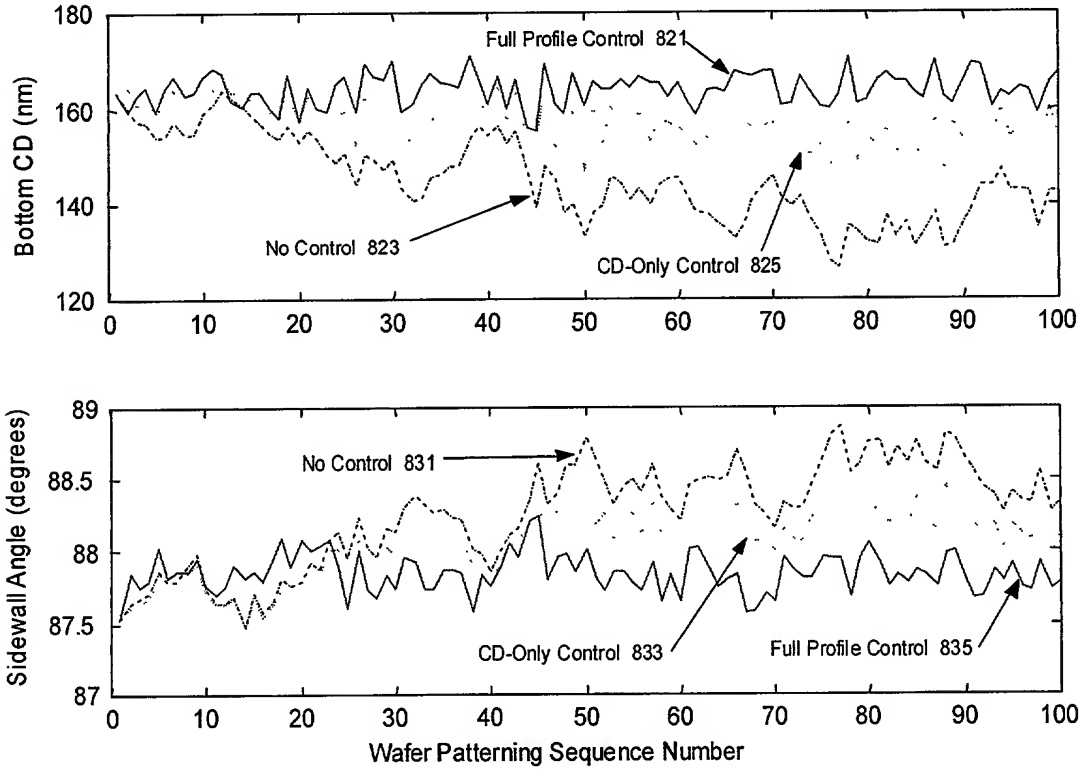

FIGURE 11B